Fig. 1

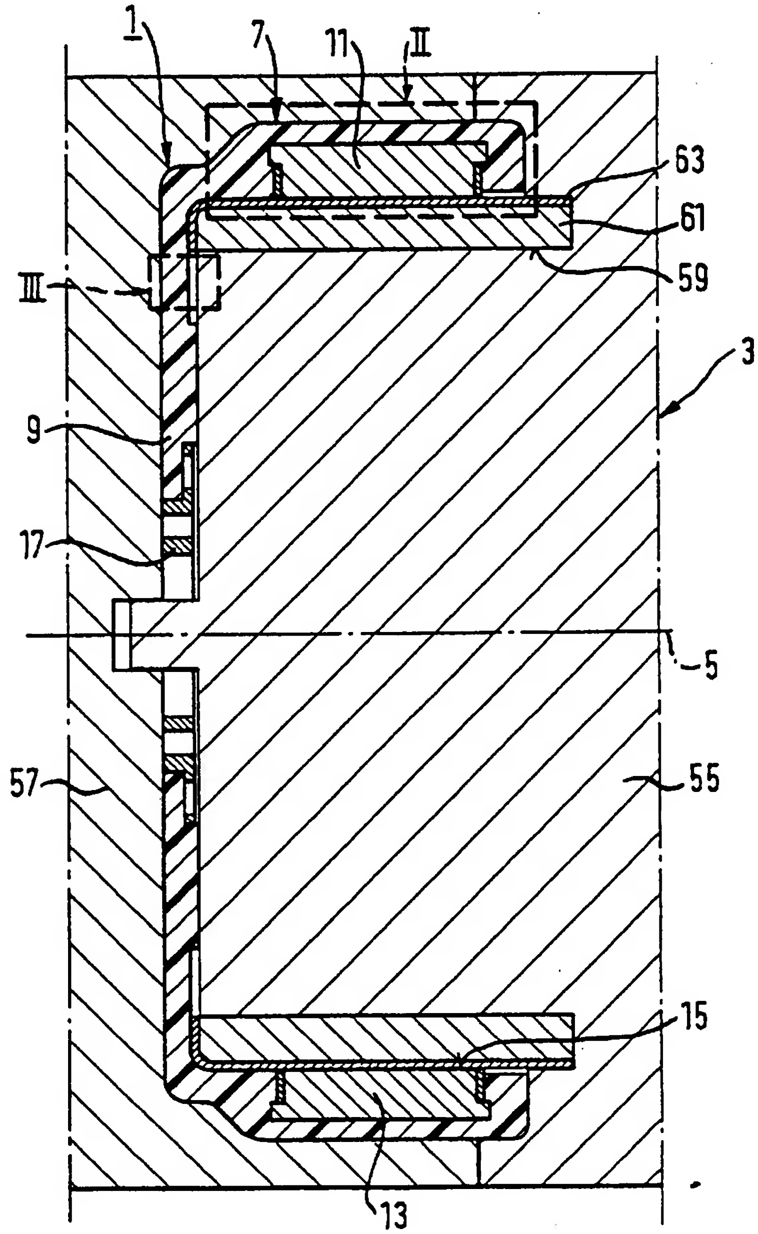
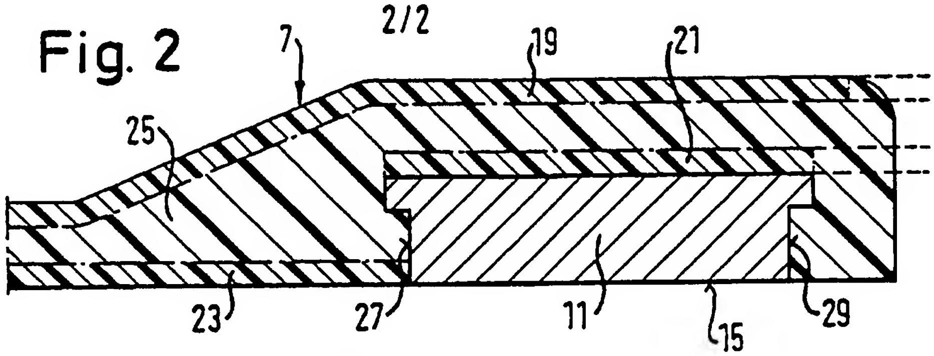


Fig. 2



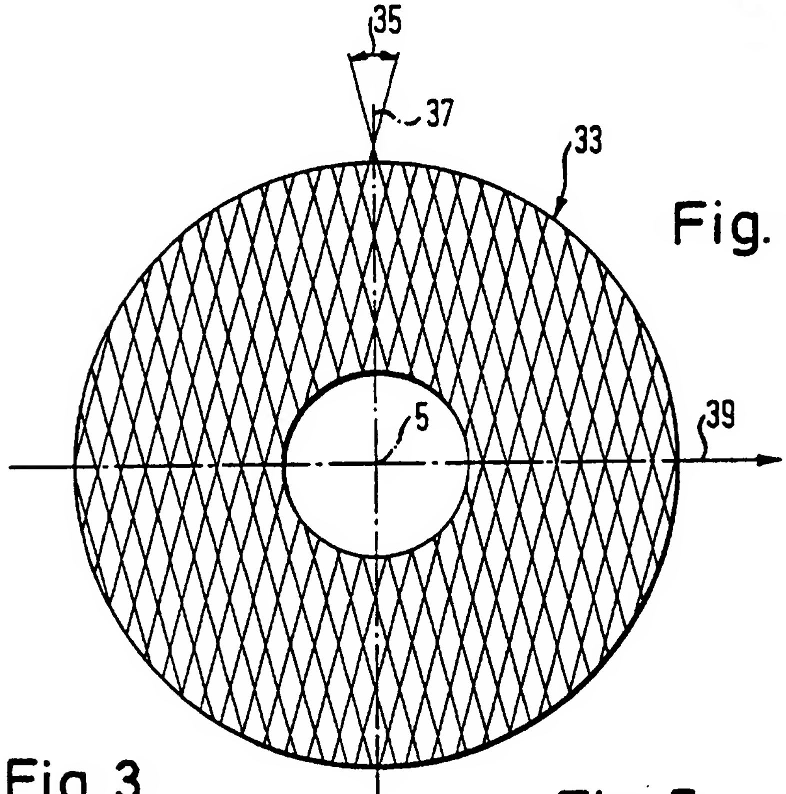


Fig. 4

Fig. 3

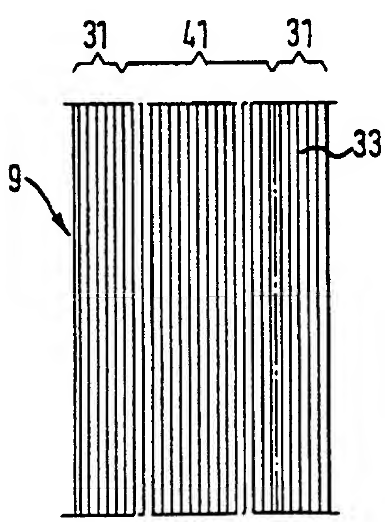


Fig. 5

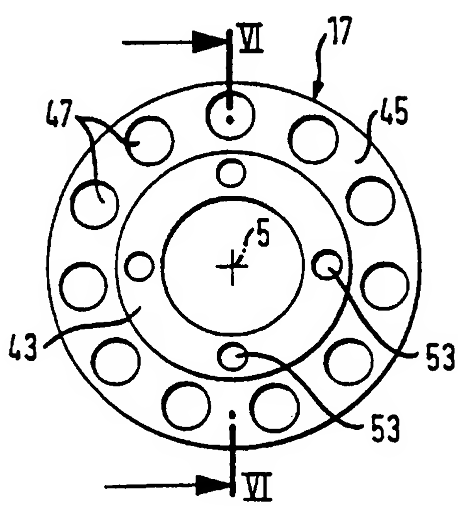
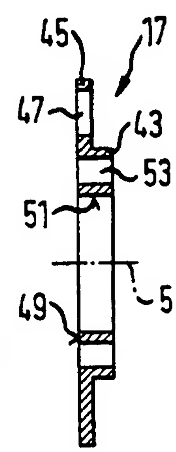


Fig. 6



2296997

ROTOR FOR AN ELECTRIC MACHINE

The invention relates to a rotor, in particular an external rotor, for an electric machine, such as an electric motor or generator, in which the rotor is mounted to rotate about an axis relative to a stator of the machine.

In conventional electric machines for use as motors or as generators and using a permanent magnet external rotor, such as for example are known from DE-A-38 06 760, the rotor has a metal hub construction and forms at its periphery a hollow cylindrical rim element. Circumferentially spaced bar-shaped permanent magnets are arranged to alternate with bar-shaped flux-guiding elements in the rim element. The centrifugal forces acting on the permanent magnets and the flux-guiding elements during operation are taken by a hoop of fibre-reinforced plastics enclosing the rim element. The glass fibres, carbon fibres or the like which reinforce the plastics material extend in a substantially circumferential direction. In external rotors running at high speeds, with high power and high torque, conventional forms of construction lead to relatively high weight and high moments of inertia.

It is the aim of the invention to provide a rotor, in particular an external rotor, for an electric machine, which is comparatively easy to produce and is of high strength.

According to a first aspect of the present invention, a rotor for an electric machine comprises a substantially cylindrical hollow rim element having a first cross-sectional region of plastics material reinforced with fibre-like and/or thread-like material extending substantially circumferentially, at least one flange element rigidly connected to the rim

element and projecting radially inwards from the rim element towards the axis of rotation, and a plurality of permanent magnets arranged circumferentially adjacent each other in the rim element, pole faces of the magnets forming at least a part of a surface of the rim element, in which the rim element has a second cross-sectional region of plastics material reinforced with fibre-like and/or thread-like material extending in a plurality of directions, each direction being at an angle of less than 45° with respect to the circumferential direction, and with at least two of the directions intersecting.

The rotor is preferably an external rotor. The rotor may also include magnetic flux-guiding means associated with the magnets and having faces forming part of the surface of the rim element.

The reinforced second region provides a rim element with very high bursting speeds and which is very stiff against bending in an axial direction. This is of particular advantage in external rotors where the rim element generally extends axially in a cantilevered manner from the flange element.

The dilation of the free edge of the rim element by centrifugal forces can lead to high bending loads on the rim element. The reinforcing of the second cross-sectional region ensures an improvement in the bending strength.

Preferably the first cross-sectional region comprises an outer and/or an inner edge region of the rim element. Where it comprises both edge regions the structure is symmetrical in cross-section. Conveniently, the second cross-sectional region is arranged over at least part of its axial extent radially between the outer and inner edge regions.

It has been found to be favourable for the directions of the reinforcing material in the second cross-sectional region to be substantially reflectionally symmetrical with respect to the circumferential direction, in order to achieve uniform stress characteristics in the rim element on centrifugal loading.

The directions of the reinforcing material in the second cross-sectional region preferably extend at an angle of between 5° and 25° to the circumferential direction. An angle between 10° and 20° has been found to be particularly favourable. The stress capability of the rim element which can be achieved in a circumferential direction is then greater than that in an axial direction by an order of magnitude. However the values which can be reached in an axial direction are sufficient to achieve a significant improvement in the bending strength of the rim element.

The reinforcing material for the first cross-sectional region, which runs in a substantially circumferential direction, can be wound from endless material. The reinforcing material in the second cross-sectional region can also be produced in layers like a cross-winding. Production is simplified if instead at least the second cross-sectional region is reinforced with a plurality of layers of a prefabricated reinforcing mat in which the fibre-like and/or thread-like reinforcing material is arranged in several predetermined directions differing from layer to layer or intersecting within the individual layers. The reinforcing mats may have substantially unidirectionally arranged fibres or threads when the direction is inclined with respect to the circumferential direction of the rim element. Successive superimposed layers then have different fibre directions, preferably arranged reflectionally symmetrically with respect

to the circumferential direction. The manufacture is still further simplified if the reinforcing material of the mat has a grid structure. Rolls can be formed in a relatively simple manner from such mats.

The first aspect of the invention relates to the rim element which carries the permanent magnets. A second independent aspect of the invention relates to the flange element which projects radially inwards from the rim element and thereby carries it. The flange element is preferably connected integrally to the rim element so that it is produced in a single working step together with the rim element, for example by injection moulding.

According to a second aspect of the present invention a rotor for an electric machine comprises a substantially cylindrical hollow rim element having a first cross-sectional region of plastics material reinforced with fibre-like and/or thread-like material extending substantially circumferentially, at least one flange element rigidly connected to the rim element and projecting radially inwards from the rim element towards the axis of rotation, and a plurality of permanent magnets arranged circumferentially adjacent each other in the rim element, pole faces of the magnets forming at least a part of a surface of the rim element, in which the flange element is of plastics material reinforced in a first axial longitudinal-section region by a plurality of substantially flat superimposed reinforcing mats, each of which includes fibre-like and/or thread-like material distributed substantially uniformly and running in a predetermined direction or a plurality of directions intersecting at substantially the same angle, and at least some of the mats are angularly offset round the axis of rotation relative to the directions of the reinforcing material.

Such a substantially annular flange element can be very easily reinforced with reinforcing mats, for example prefabricated and of annular shape. The reinforcing mats or groups of mats are preferably arranged angularly offset round the axis of rotation in a periodic offset pattern totalling 360°, so that substantially uniform strength characteristic are obtained circumferentially. Mats having substantially unidirectionally arranged fibres can be employed, but reinforcing mats with a grid structure are particularly suitable. Preferably the directions of the fibres have an included angle which is other than 90°. Thereby the reinforcing mats have a preferred direction in which they can be highly loaded, whilst the loading capacity in a transverse direction is smaller. The reduced load capacity in this direction is sufficient, in a flange element reinforced by such a stack of mats, to ensure uniform distribution in a circumferential direction of the radial load capability.

Also for the flange element a "sandwich" construction has been found advantageous. The first axial longitudinal-sectional region preferably forms at least one edge region of the flange element, and preferably both edge regions, i.e. both side face regions. A second axial longitudinal-sectional region is provided between the two edge regions, the second axial longitudinal-sectional region being of plastics material with a different reinforcing structure. The second region is preferably arranged at least over part of its radial extent between the two edge regions. In some cases reinforcement can be dispensed with in this region. However preferably the second region is reinforced with a plurality of substantially flat superimposed reinforcing mats with reinforcing fibres and/or threads distributed uniformly in the form of a grid. In the second axial longitudinal-sectional region it is however sufficient for the mats to form a rectangular intersecting grid or to be in the form of mats of random fibres.

The reinforcing material for the plastics material of the rim element and/or the flange element preferably comprises a prefabricated reinforcing body. In the manufacture of the rotor this body only needs to be inserted in the external mould of the injection mould designed to produce the rotor. The reinforcing body of the rim element is preferably integral with the reinforcing body of the flange element. The two may be separate, however. The individual reinforcing mats or the like in this arrangement are mechanically connected together by suitable fixing means in order to allow the reinforcing body to be placed in the injection mould without problems. Particularly suitable plastics materials are those adapted to be shaped in the two-component injection moulding process called reaction injection moulding (RIM process).

A further feature provides that an annular metal hub component is cast into the flange element. This simplifies the manufacture of the rotor in general, and facilitates its matching to different fields of use. The hub component has a free axial and/or radial connecting face and simply forms an "adapter" to which, in accordance with the particular use, a bearing member or a shaft or the like can be secured. The hub component with its free connecting face simply forms a seating on which the connecting component is located and secured.

In a preferred embodiment the hub component has a plurality of

It will be understood that any conventional fibre-like or thread-like reinforcing materials can be employed as the reinforcing material. Glass fibres or carbon fibres are particularly suitable.

The thickness of the first cross-sectional region forming the edge regions of the rim element and the first axial longitudinal-sectional regions forming the edge regions of the flange element preferably amounts to a 1/5 to 1/3 of the overall thickness of the region of the rim element or flange element made of plastics.

A third aspect of the invention relates to a method of manufacture which is particularly suitable for the construction of the rotor of an electric machine.

According to a third aspect of the present invention, a method of manufacturing a rotor for an electric machine, in which the rotor is mounted rotatably about an axis of rotation relative to a stator of the machine, the rotor comprising a substantially cylindrical hollow rim element, a flange element rigidly connected to the rim element and projecting radially inwards from the rim element towards the axis of rotation and a plurality of permanent magnets arranged circumferentially adjacent each other in the rim element, pole faces of the magnets forming at least a part of a surface of the rim element, at least part of the rotor being of plastics material which is reinforced with fibre-like and/or thread-like reinforcing material, comprises the steps of

a) mounting the permanent magnets on a locating body of a multi-part injection mould having locating faces so that the permanent magnets engage the locating faces,

b) applying the reinforcing material and

c) closing the mould and injecting the plastics material.

In such a method the permanent magnets are held in place by the plastics material of the rim element injected around them. Securing problems, such as for example could arise by using adhesive to secure the magnets to prefabricated plastics rotors, are thereby avoided. The RIM process previously mentioned is particularly suitable for use in the method.

Where the rotor also includes magnetic flux-guiding means associated with the magnets and having faces forming part of the surface of the rim element, step a) includes mounting the flux-guiding means on the locating body for engagement with the locating faces.

The locating body having the locating faces can be an integral component of a mould body of the injection mould. It is however more favourable from the manufacturing point of view in step a) for the magnets and any flux-guiding means to be pre-assembled into a tubular locating body adapted to be removed completely from the mould, and the magnets, flux-guiding means and the locating body to be placed in a first part of the multi-part injection mould. In this way the magnets and the flux-guiding means can be pre-assembled outside the moulding machine and inserted into the mould as a unit.

The locating body is preferably made at least partially of magnetic material, for example soft iron, so that the magnets and any flux-guiding means are held on the locating body by the magnetic forces of the

magnets. It is furthermore advantageous for the direct locating face of the locating body to be made of non-magnetic material, preferably V4A steel, in order on the one hand to reduce the magnetic adhesive forces and on the other hand not to damage the magnets on removal as a consequence of high magnetic adhesion forces. If the permanent magnets are inserted as unmagnetised blanks which are only magnetised after being enclosed in plastics, the magnet bodies and magnetic flux-guiding means can also be secured in other ways, for example by additional hoops, bands or the like.

Particularly preferred is an embodiment in which in step b) a reinforcing body assembly including at least one annular reinforcing body is prefabricated from the fibre-like and/or thread-like reinforcing material and is positioned relative to the locating body. The locating body provided with the magnets can be inserted in the injection mould together with the reinforcing body assembly; however preferably the reinforcing body assembly is inserted first, after which the locating body is inserted in the mould. The reinforcing body assembly may comprise a single annular reinforcing body which includes the reinforcing material for incorporation in the rim element and that for incorporation in the flange element. However, the reinforcing material for the rim element and the flange element could be prefabricated as separate annular reinforcing bodies.

An embodiment of the invention is illustrated by way of example in the accompanying drawings in which:-

Figure 1 is an axial longitudinal section through an external rotor for an electric machine during its manufacture;

Figure 2 is a detailed view of a rim element of the rotor indicated by the arrow II in Figure 1;

Figure 3 is a detailed view of a flange element of the rotor in accordance with the arrow III in Figure 1;

Figure 4 is a plan view of a reinforcing mat used in the manufacture of the flange element;

Figure 5 is a plan view of a hub component cast into the flange element; and

Figure 6 is an axial longitudinal section through the hub component taken on a line VI-VI in Figure 5.

Figure 1 shows a plastics external rotor 1 for an electric machine, for example a motor or a generator, in stage of its manufacturing process before removal from an injection mould 3. The rotor 1 is of the permanent magnet type, such as is described in principle in DE-A-38 06 760. The plastics material of the rotor 1 includes a hollow cylindrical rim element 7 concentric with an axis of rotation 5 of the rotor 1 and merging integrally in the region of one of its two axial ends with a substantially annular flange element 9 which extends radially inwards towards the axis 5.

In the electric machine the rotor 1 has an associated stator (not shown), relative to which the rotor 1 rotates about the axis 5. The stator projects into the cavity defined by the rim element 7 and has at its outer periphery a number of circumferentially spaced poles provided with windings. The poles lie opposite permanent magnets 11 provided in the

external rotor 1. The magnets 11 are circumferentially arranged with close radial spacing round the rim element 7 and with alternating polarity. The magnets 11 are of bar shape and extend substantially parallel to the axis 5. They are separated from one another circumferentially by flux-guiding wedges 13 of magnetic material, which each define a pole face 15 on the radially inner surface of the rim element 7, the pole faces being common with the circumferentially adjacent permanent magnets, as explained in DE-A-38 06 760.

For the attachment of the rotor 1 to a bearing sleeve or flange or to a shaft of the electric machine (not shown) the flange element 9 is rigidly secured at its radially inner region to a hub component 17, which is of annular shape. The hub component 17 extends over only a part of the radial extent of the flange element 9 and is moulded into the plastics material of the rotor 1 along with the magnets 11 and flux-guiding wedges 13.

The rim element 7 and the flange element 9 are reinforced by fibre-like and/or thread-like reinforcing material, such as glass fibres or in particular carbon fibres. Figures 2 to 4 show details of this reinforcement. The reinforcements are of "sandwich-like" construction and have a reinforcing structure in the edge regions of the rim element 7 and flange element 9 which differs from the central region. In this way high degrees of strength and thereby high bursting speeds can be achieved.

Figure 2 shows the reinforcing structure of the rim element 7. The reinforcing fibres extend parallel and only in a substantially circumferential direction in an outer edge region 19, a first inner edge region 21 enclosing the magnets 11 and the flux-guiding wedges 13, and a

second inner edge region 23 axially adjacent the pole faces 15 of the magnets 11 and flux-guiding wedges 13. Between the outer edge region 19 and the inner edge regions 21, 23 there is an intermediate central region 25 which encloses the magnets 11 and flux-guiding wedges 13 at their axial end faces 27, 29 (Figure 2) and locates them immediately both axially and radially. In the intermediate region 25 the reinforcing fibres extend in several directions, each direction being at an angle of 10° to 20° with respect to the circumferential direction, and with at least two of the directions intersecting. The reinforcing structure of the rim element 7 can be produced by controlled winding of the reinforcing fibres. In the edge regions 19, 21 and 23 the winding is done in a substantially circumferential direction, while in the intermediate regions 25 the winding is done with crossings, alternating from point to point between a positive and negative angle of inclination to the circumferential direction. In a modification, the reinforcement of at least the intermediate region 25 can comprise at least one reinforcing grid mat in which the threads of the grid extend at an angle to one another which is not equal to 90°. The or each reinforcing grid mat is arranged so that the reinforcing fibres have an angle between 10° and 20° with respect to the circumferential direction. Several reinforcing mats could be incorporated as individual layers with their directions offset with respect to the circumferential direction; however it is preferred that one reinforcing mat is prepared in the form of a strip which is wound into the desired number of layers.

Whereas the edge regions 19 to 23 primarily take the maximum circumferential tension stresses, the intermediate region 25 also takes axially directed stresses and thereby increase the bending strength of the rim element 7, which is held in a cantilevered manner on the flange element 9.

The total radial thickness of the edge regions 19 and 21 amounts to about 1/5 to 1/3 of the overall thickness of the rim element 7 in the region directly radially over the magnets 11 and flux wedges 13. The total radial thickness of the edge regions 19 and 23 in the region of the transition to the flange element 9 is also about 1/5 to 1/3 of the overall thickness.

As shown in detail in Figure 3, the flange element 9 is reinforced by a plurality of flat annular superimposed reinforcing grid mats in a stack. In axial edge regions 31 of the flange element 9 the reinforcing mats 33 are in accordance with Figure 4, in which the reinforcing fibres extend parallel to one another in groups within the reinforcing mats and intersect at an angle which is not equal to 90°. The acute angle of intersection indicated at 35 in Figure 4 lies between 20° and 40°. The reinforcing mats 33 of the edge regions 31 thereby have a higher tensile strength in the preferred direction 37 which extends in the direction of the angle bisecting the acute angle of intersection 35, whilst those in the direction 39 which extend in the direction of the line bisecting the obtuse angle of intersection have a lower tensile strength. In the given range of angles the tensile strength in the direction 37 is for example 10 times greater than in the direction 39.

In order to achieve a uniform distribution of the tensile strength capability of the flange element 9 in a circumferential direction, the reinforcing grid mats 33 in the edge regions 31 are incorporated periodically angularly offset from one another in such a way that there is obtained a pattern which extends through 360°. The edge regions 31 may include for example at least three reinforcing grid mats 33 offset by 120° with respect to one another. With an increasing number of reinforcing grid mats 33 incorporated in the edge region 31 the offset angles becomes smaller.

The flange element 9 also has an intermediate central region 41 arranged in a sandwich-like manner between the edge regions 31. The intermediate region 41 may be made of the same form as the edge regions 31; it can however also be made entirely without reinforcement or can be reinforced with comparatively short staple fibres or the like. The intermediate region 41 can advantageously be reinforced likewise with staple reinforcing grid mats, but in this region the reinforcing fibres intersect at right angles. The reinforcing grid mats may be arranged with an angular offset with respect to the direction of their fibres, or may be introduced as completely random fibres.

The total axial thickness of the edge regions 31, like the intermediate region 25, amounts to 1/5 to 1/3 of the overall axial thickness of the flange region 9.

Figure 5 and 6 show details of the hub component 17. The hub component 17 comprises an annular disc with an annular thickened base body 43 of which the thickness corresponds substantially to the thickness of the flange element 8. An anchorage member comprising a flange 45 projects radially outwards from the base body 43. The anchorage flange 43 has a reduced axial width and is provided with a number of circumferentially spaced anchorage holes 47. When the anchorage flange 45 is penetrated by plastics material of the flange element 9 and at least partially enclosed in it, the base body 43 lies outside the plastics region. In this way the base body 43 forms free axial faces 49 and free annular radial seating faces 51, which can be used for locating and securing attachment members, bearing spigots, flange portions or the like (not shown), according to the use required. Attachment holes for attaching

these connecting components are provided at 53, radially inwards of the anchorage flange 45.

Instead of the hub component 17 a ready-machined shaft or a bearing insert or the like could be incorporated directly in the rotor 1 as a complete inserted component.

Figure 1 shows further details of the injection mould 3 used for manufacturing the external rotor 1. It comprises two mutually complementary mould parts 55, 57 defining cavities which determine the external shape of the rotor 1. One of the parts, in this case the body 55, has guide faces 59 for centring and axially locating a tubular locating body 61. The locating body 61 is made of magnetic material, such as soft iron and has on its external surfaces a layer 63 of non-magnetic material, such as stainless steel.

For the manufacture of the external rotor 1 the magnets 11 and flux wedges 13 are mounted and positioned in a mounting jig separate from the mould 3 (not shown), on the locating body 61 which has been completely removed from the mould 3. The radial forces retaining the magnets 11 and flux wedges 13 on faces in the body 61 are applied by the magnetic forces of the permanent magnets 11. The non-magnetic layer 63 provided between the magnets 11 and the magnetic locating body 61 limits the attractive forces of the comparatively strong permanent magnets to a value which eases the removal of the finished rotor 1 from the mould 3.

After the insertion of the locating body 61 with the magnets 11 and flux-guiding wedges 13 in the mould part 55, the reinforcing structures mentioned earlier are applied and the hub component 17 is inserted.

It will be understood that the reinforcing structures could if necessary be at least partially placed in the mould part 55 before insertion of the loaded locating body 61, which can be of advantage in particular with reinforcing structures which are wound in situ. However preferably the reinforcing structures are prefabricated to form at least one annular closed reinforcement body which has sufficient strength to enable it to be axially slipped on or placed in one working step.

After the placing of the reinforcement and the insertion of the hub component 17 the second mould part 57 is applied and the injection mould is closed. A two-component plastics material is injected through injection channels (not shown) in accordance with the "reaction-injection-moulding" process (RIM process). The material penetrates the matrix of reinforcing fibres and fills the mould cavity. The permanent magnets 11 and the flux-guiding wedges 13 are cast in, including their undercuts, apart from the exposed pole faces 15. Plastics material suitable for the RIM process are known; suitable materials are caprolactam-based nylon materials. After curing of the plastics material the mould parts 55 , 57 are separated and the rotor 1 is removed.

CLAIMS

1. A rotor for an electric machine comprising a substantially cylindrical hollow rim element having a first cross-sectional region of plastics material reinforced with fibre-like and/or thread-like material extending substantially circumferentially, at least one flange element rigidly connected to the rim element and projecting radially inwards from the rim element towards the axis of rotation, and a plurality of permanent magnets arranged circumferentially adjacent each other in the rim element, pole faces of the magnets forming at least a part of a surface of the rim element, in which the rim element has a second cross-sectional region of plastics material reinforced with fibre-like and/or thread-like material extending in a plurality of directions, each direction being of an angle of less than 45° with respect to the circumferential direction, and with at least two of the directions intersecting.

2. A rotor as claimed in claim 1, in which the rotor is an external rotor.

3. A rotor as claimed in claim 1 or claim 2, in which magnetic flux-guiding means are associated with the magnets, and have faces forming part of the surface of the rim element.

4. A rotor as claimed in any preceding claim, in which the first cross-sectional region comprises an outer and/or an inner edge region of the rim

6. A rotor as claimed in any preceding claim, in which the directions of the reinforcing material in the second cross-sectional region are substantially reflectionally-symmetrical with respect to the circumferential direction.

7. A rotor as claimed in any preceding claim, in which the directions of the reinforcing material in the second cross-sectional region are at an angle between 5° and 25° with respect to the circumferential direction.

8. A rotor as claimed in claim 7, in which the angle is between 10° and 20°.

9. A rotor as claimed in any preceding claim, in which in at least the second cross-sectional region the reinforcing material comprises a plurality of layers of a prefabricated reinforcing mat, in which the fibre-like and/or thread-like reinforcing material is arranged in several predetermined directions differing from layer to layer or intersecting within the individual layers.

10. A rotor as claimed in claim 9, in which the reinforcing material of the mat has a grid structure.

11. A rotor as claimed in claim 9 or claim 10, in which the reinforcing mat forms a roll.

12. A rotor for an electric machine comprising a substantially cylindrical hollow rim element having a first cross-sectional region of plastics material reinforced with fibre-like and/or thread-like material extending substantially circumferentially, at least one flange element

rigidly connected to the rim element and projecting radially inwards from the rim element towards the axis of rotation, and a plurality of permanent magnets arranged circumferentially adjacent each other in the rim element, pole faces of the magnets forming at least a part of a surface of the rim element, in which the flange element is of plastics material reinforced in a first axial longitudinal-sectional region by a plurality of substantially flat superimposed reinforcing mats, each of which includes fibre-like and/or thread-like material distributed substantially uniformly and running in a predetermined direction or a plurality of directions intersecting at substantially the same angle, and at least some of the mats are angularly offset round the axis of rotation relative to the directions of the reinforcing material.

13. A rotor as claimed in claim 12, in which intersecting directions in the reinforcing mats have an included angle not equal to 90°.

14. A rotor as claimed in claim 12 or claim 13, in which the reinforcing mats or groups of reinforcing mats are arranged angularly offset about the axis of rotation in a periodic offset pattern totalling 360°.

15. A rotor as claimed in any of claims 12 to 14, in which the first axial longitudinal-sectional region forms at least one edge region of the flange element.

16. A rotor as claimed in claim 15, in which a second axial longitudinal-sectional region is provided between two edge regions, the second axial longitudinal-sectional region being of plastics material with a different reinforcing structure.

17. A rotor as claimed in claim 17, in which the second axial longitudinal sectional region is arranged at least over a part of its radial extent between two edge regions.

18. A rotor as claimed in claim 16 or claim 17, in which the second axial longitudinal sectional region is reinforced with a plurality of substantially flat superimposed reinforcing mats, each of which includes fibre-like and/or thread-like reinforcing material distributed uniformly within the reinforcing mat in the form of a grid.

19. A rotor as claimed in claim 18, in which the directions of the reinforcing material in the reinforcing mats of the second axial longitudinal-section region intersect substantially at right angles.

20. A rotor as claimed in any preceding claim, in which the reinforcing material for the plastics material of the rim element and/or of the flange element comprises a prefabricated reinforcing body.

21. A rotor as claimed in claim 20, in which the reinforcing body of the rim element is integral with the reinforcing body of the flange element.

22. A rotor as claimed in any preceding claim, in which the plastics material is adapted to be formed in a two-component injection moulding process.

23. A rotor as claimed in any preceding claim, in which an annular metal hub component is cast into the flange element.

24. A rotor as claimed in claim 23, in which the hub component has a free axial and/or radial connecting face.

25. A rotor as claimed in claim 23 or claim 24, in which the hub component has a plurality of circumferentially spaced anchorage members embedded in the plastics material of the flange element, and a plurality of attachment members arranged radially inwards of the pitch circle of the anchorage members in a free connecting face.

26. A method of manufacturing a rotor of an electric machine, in which the rotor is mounted rotatably about an axis of rotation relative to a stator of the machine, the rotor comprising a substantially cylindrical hollow rim element, a flange element rigidly connected to the rim element and projecting radially inwards from the rim element towards the axis of rotation and a plurality of permanent magnets arranged circumferentially adjacent each other in the rim element, pole faces of the magnets forming at least a part of a surface of the rim element, at least part of the rotor being of plastics material which is reinforce with fibre-like and/or thread-like reinforcing material, the method comprising the steps of

a) mounting the permanent magnets on a locating body of a multi-part injection mould having locating faces so that the permanent magnets engage the locating faces,

b) applying the reinforcing material and

c) closing the mould and injecting the plastics material.

27. A method as claimed in claim 26, in which the rotor includes magnetic flux-guiding means associated with the magnets and having faces forming part of the surface of the rim element, and in which step a) includes mounting the flux-guiding means on the locating body for engagement with the locating faces.

28. A method as claimed in claim 27, in which in step a) the magnets and magnetic flux-guiding means are pre-assembled onto a tubular locating body adapted to be completely removed from the mould and the magnets, flux-guiding means and locating body are placed in a first part of the multi-part injection mould.

29. A method as claimed in any of claims 26 to 28, in which the locating body is made at least partially of magnetic material.

30. A method as claimed in any of claims 26 to 29, in which in step b) a reinforcing body assembly including at least one annular reinforcing body is prefabricated from the fibre-like and/or thread-like reinforcing material and is positioned relative to the locating body.

31. A method as claimed in claim 30, in which the reinforcing body assembly is inserted relative to the locating body after the locating body has been inserted in a first part of the mould.

32. A rotor for an electric machine substantially as described herein with reference to and as illustrated in the accompanying drawings.

33. A method of manufacturing a rotor for an electric machine substantially as described herein with reference to and as illustrated in the accompanying drawings.

The Patent Office

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Application No: GB 9524725.0
Claims searched: 1 - 11
Examiner: John Cockitt
Date of search: 15 February 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): H2A [AKH2, AKF2, AKC6]; F2T [T15]; B3A

Int Cl (Ed.6): H02K [01/27,01/28, 15/03]; F16F [15/305]; F16C [15/00]

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB2261327A	TURBO - see fig 6 and description	1 at least
X	GB2250642A	SUINDSTRAND - see figs 3-6	1 at least

X Document indicating lack of novelty or inventive step	A Document indicating technological background and/or state of the art.
Y Document indicating lack of inventive step if combined with one or more other documents of same category.	P Document published on or after the declared priority date but before the filing date of this invention.
	E Patent document published on or after, but with priority date earlier than, the filing date of this application.
& Member of the same patent family	

The Patent Office

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Application No:	GB 9524725.0	**Examiner:**	John Cockitt
Claims searched:	12-25	**Date of search:**	16 April 1996

Patents Act 1977
Further Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): H2A [AKH2, AKF2, AKC6]; F2T [T15]; B3A

Int Cl (Ed.6): H02K [01/27,01/28, 15/03]; F16F [15/305]; F16C [15/00]

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
	NONE	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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